Accidental fires result in enormous amount of property damage and endanger people and environment. Smoke and toxic gas inhalation cause the majority of fire fatalities. The inhalation of a large concentration of toxic gas and soot may lead to lung edema and inflammation, causing death a short time after the fire. Toxic effluents can either be set free or be produced during a fire and can affect people directly through air, ground water or surface water and deposit in soil and plants. Therefore, a complete fire hazard assessment requires the knowledge of toxic chemical species production (CO, NOx, SOx, H2S, HCN, COS, HCl etc.). Species production is mainly affected by the chemical properties of burning matter and also by the confinement, ventilation, fluid dynamics, thermal environment and mode of burning i.e. by the combustion conditions. In the majority of accidental fires, the thermochemical characteristics of the burning material and the combustion conditions depend on a lot of accidental influences that lead to more or less different results. Therefore, experimental studies of large fires, which are very expensive, would have to be repeated several times while condition is being changed. Numerical simulations provide a promising tool to complement the experimental studies, to improve our understanding and to allow a stochastic approach for the fire safety risk assessment. For calculating very detailed fire effects, e.g. gas concentration in a special area of a confinement, CFD (Computational Fluid Dynamics) models can be used with enormous computational effort. Fire toxicant assessment in terms of a modelling approach including chemical equilibrium calculation of the burning matter at variable combustion conditions and Global equivalence Ratio (GER-φ) is being performed in this thesis. Following part of the risk management processes are involved in the thesis:

- Fire probability
- Fire protection
- Toxicant assessment
  (Toxicant production Submodel)
- CFD model
- Fire hazard assessment
- Fire probability assessment
- Fire risk mitigation
The goals of this thesis are as follows

- Calculation of the Chemical equilibrium concentration during the combustion of wood, polymethylmethacrylate (PMMA) polyurethane, poly vinyl chloride (PVC), polypropylene and other combustible substances used in airports, tunnels or power plants will be performed. Detailed investigations of the effect of Global Equivalence Ratio (GER) and temperature on fire products for different burning substances have to be performed.
- Using CFD model, a model has to be found out and improved which gives the probability of fire growth.
- Effort has to be given for finding out the possibility to calculate the probability of local pollutant concentrations of a specific fire resulting from the residence time of smoke at different GERs and temperatures.
- Fire prevention measures like the design of rooms, the early fire identification and the automatic fire fighting measures and ventilations etc. will be assessed.
- Typical examples will be simulated for the proposed fire protection improvements.